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CLAIMS

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[Claim(s)]

[Claim 1] the 1st cooling circulatory system which has a sealing form ventilation flue containing a liquid crystal panel, and the 2nd cooling circulatory system which is in an equipment outer shell and cools this ventilation flue from an outside -- having -- this liquid crystal panel -- this -- the 1st cooling circulatory system -- direct -- cooling -- this -- optical equipment characterized by configuration indirectly cooled in the 2nd cooling circulatory system.

[Claim 2] The cooling circulatory system of the above 1st is optical equipment according to claim 1 which is the configuration equipped with a cooling fan of dedication.

[Claim 3] It is optical equipment which irradiates light at two or more liquid crystal panels, possesses two or more cooling fans for cooling a liquid crystal panel in optical equipment which projects light from this liquid crystal panel on a screen through two or more prism and projection lenses, and is characterized by one [ at least ] of these the cooling fans being a configuration arranged in the side of this projection lens.

[Claim 4] It is optical equipment characterized by irradiating light at two or more liquid crystal panels, providing two or more cooling fans for cooling this liquid crystal panel in optical equipment which projects light from this liquid crystal panel on a screen through two or more prism and projection lenses, and one [ at least ] of these the cooling fans being a sirocco fan.

[Claim 5] One of two or more above-mentioned cooling fans is optical equipment according to claim 3 or 4 which is the cooling fan of dedication for cooling the above-mentioned liquid crystal panel at least.

[Claim 6] It is optical equipment according to claim 3, 4, or 5 which is the configuration that have an air course for cooling to the above-mentioned liquid crystal panel, and this air course for cooling is divided into plurality.

[Claim 7] An air course for cooling divided into the above-mentioned plurality is optical equipment according to claim 6 which is the configuration of having made it increase a wind speed or airflow to a liquid crystal panel for G colored light (18).

[Claim 8] Optical equipment according to claim 1, 2, 3, 4, 5, 6, or 7 whose plane dimension is below an abbreviation A4 file size.

[Claim 9] The above-mentioned A4 file size is optical equipment according to claim 8 which is 263mmx318mm.

[Claim 10] Carry out color separation of the light from the light source, and irradiate the 1st liquid crystal panel, the 2nd liquid crystal panel, and the 3rd liquid crystal panel, and color composition of the outgoing radiation light from the 1st liquid crystal panel, the 2nd liquid crystal panel, and the 3rd liquid crystal panel is carried out. Optical equipment according to claim 1, 2, 3, 4, 5, 6, or 7 which a plane size which contains a height of a liquid crystal projector at the time of receipt at least in a liquid crystal projector projected on a screen with a projection lens made a dimension below an abbreviation A4 file size.

[Claim 11] Optical equipment according to claim 10 which set the above-mentioned A4 file size to 263mmx318mm.

[Claim 12] Optical equipment according to claim 8 or 10 which set the above-mentioned A4 file size to 243mmx307mm.

[Claim 13] Optical equipment according to claim 8 or 10 which set the above-mentioned A4 file size to 230mmx307mm.

[Claim 14] Optical equipment according to claim 8 or 10 which made display screen size of a liquid crystal panel 0.9 inches or less.

[Claim 15] Optical equipment according to claim 8 or 10 which set distance from the liquid crystal panel screen to a projection lens tip to 146mm or less.

[Claim 16] Optical equipment according to claim 8 or 10 which set distance from the liquid crystal panel screen to a projection lens tip to 135mm or less.

[Claim 17] Optical equipment according to claim 8 or 10 which a plane size of a crossing dichroic prism made less than [ 32mmx32mm ] while having a crossing dichroic prism as color composition optical system.

[Claim 18] Optical equipment according to claim 8 or 10 which has both arranged a projection lens, a crossing dichroic prism, color separation optical system, an illumination-light study system, and a power supply for the light sources in this order as it is characterized by providing the following The light source for raising use effectiveness of illumination light from the light source, and obtaining uniform illumination light, while equipping the perimeter of a crossing dichroic prism with the 1st dichroic mirror, the 2nd dichroic mirror, the 1st mirror, the 2nd mirror, and the 3rd mirror as color separation optical system, a polarization sensing element, an illumination-light study system including an optical integrator means A power supply for the light sources

[Claim 19] While equipping the perimeter of a crossing dichroic prism with the 1st

dichroic mirror, the 2nd dichroic mirror, the 1st mirror, the 2nd mirror, and the 3rd mirror as color separation optical system While having an illumination-light study system including the light source for raising use effectiveness of illumination light from the light source, and obtaining uniform illumination light, a polarization sensing element, and an optical integrator means, and a power supply for the light sources A list of a projection lens, a crossing dichroic prism, and color separation optical system, and an illumination-light study system, optical equipment according to claim 8 or 10 which has arranged a power supply for the light sources in this order.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the technology which cools a liquid crystal panel especially with respect to optical equipments, such as a liquid crystal projector which uses a transparency mold liquid crystal panel.

[0002]

[Description of the Prior Art] In order to suppress the temperature rise of a liquid crystal panel like a publication with the optical equipment using two or more conventional prism in the projector lens of a liquid crystal projector shown in Fig. 2, and the side elevation of a liquid crystal panel portion, it is common to arrange the cooling fan 81 of an axial flow mold under the liquid crystal panels 14, 18, and 21. in this case -- since the ventilation from a fan is hit to the direct liquid crystal panels 14, 18, and 21 (not shown) -- easy -- the above-mentioned liquid crystal panels 14 and 18 -- it can cool 21 times.

[0003]

[Problem(s) to be Solved by the Invention] In the conventional optical equipment shown in Fig. 2, the whole equipment height size turns into the projector lens 27 shown in Fig. 2 and liquid crystal panels 14 and 18, and the height size L2 added to the height size of 21 portions. Moreover, at this time, the space (dead space) which is hard to use effectively under said projector lens 27 is generated, and it is disadvantageous for reduction of the height size of the whole equipment.

[0004] It is in the purpose of this invention reducing a height size and offering optical equipment effective in the miniaturization of equipment.

[0005]

[Means for Solving the Problem] By this invention, in order to attain the above-mentioned purpose, as shown in Fig. 1, a cooling fan 61 is arranged to the side of a projector lens 27, and a cooling configuration effective in a miniaturization and thin-shape-izing is offered by considering ventilation from a cooling fan 61 as a configuration which leads liquid crystal panels 14, 18, and 21 through the ventilation path 65.

[0006] Furthermore by this invention, it considers as a configuration which reduces pressure loss by passage resistance and can cool efficient by using the above-mentioned cooling fan 61 as a blower-type sirocco fan.

[0007] Furthermore by this invention, it considers as a configuration which can control airflow and a wind speed freely so that a temperature rise of each liquid crystal panel becomes the minimum to liquid crystal panels 14, 18, and 21 about ventilation from the above-mentioned cooling fan 61.

[0008] it considers as a configuration which can control airflow and a wind speed freely so that a temperature rise of each liquid crystal panel equalizes ventilation from the above-mentioned cooling fan 61 to liquid crystal panels 14, 18, and 21, and airflow and a wind speed to the liquid crystal panel 18 for G colored light boil airflow and a wind speed to each liquid crystal panel, and it is made to become max, and is made for airflow and a wind speed to the liquid crystal panel 14 for R colored light to become min further by this invention furthermore

[0009]

[Embodiment of the Invention] Hereafter, the example of this invention is explained using a drawing.

[0010] Fig. 3 is the plan of the liquid crystal projector of the 1st example of this invention.

[0011] Incidence of the illumination light 2 from the discharge lamp 1 which is the light source is carried out to a dichroic mirror 10 through the polarization sensing element 6, the 1st lens array 7, a mirror 8, and the 2nd lens array 9 through the lamp reflector 3 of a parabolic mirror, a lens 4, and a lens 5.

[0012] The R colored light 11 penetrates a dichroic mirror 10, and G and the B colored light 12 reflect it. It is reflected by the mirror 13 and incidence of the R colored light 11 is carried out to the liquid crystal panel 14 for R colored light. Incidence is carried out to the dichroic mirror 15 of G colored light reflection and B colored light transparency, the G colored light 16 reflects, and the B colored light 17 penetrates G and the B colored light 12. Incidenc of the G colored light 16 is carried out to the

liquid crystal panel 18 for G colored light.

[0013] Incidence of the B colored light 17 is carried out to the liquid crystal panel 21 for B colored light through a mirror 19 and a mirror 20.

[0014] Color composition is carried out with the crossing dichroic prism 25, and the R transmitted light 22 from a liquid crystal panel 14, the G transmitted light 23 from a liquid crystal panel 18, and the B transmitted light 24 from a liquid crystal panel 21 project the outgoing radiation light 26 by which color composition was carried out on a screen (not shown) with the projection lens 27.

[0015] In order that the heat generated from the light source which becomes an elevated temperature does not do effect and may carry out it to component parts other than the light source, near a discharge lamp 1 and the lamp reflector 3, the ventilating fan 28 for light source cooling is arranged, and hot blast 30 is exhausted besides the case 29 of a liquid crystal projector. Moreover, the lamp power supply 31 is arranged near the discharge lamp 1.

[0016] In this example, as color separation optical system While equipping the perimeter of the crossing dichroic prism 25 with the 1st dichroic mirror 10, the 2nd dichroic mirror 15, the 1st mirror 13, the 2nd mirror 19, and the 3rd mirror 20 The use effectiveness of the illumination light from the light source Make it improve and the uniform illumination light The discharge lamp 1 and the lamp reflector 3 which are the light source for obtaining, a lens 4, a lens 5, the polarization sensing element 6, the 1st lens array 7 that is an optical integrator means, a mirror 8, and the illumination-light study system containing the 2nd lens array 9, While having the lamp power supply 31 which is a power supply for the light sources, the projection lens 27, the crossing dichroic prism 25, color separation optical system, the illumination-light study system, and the lamp power supply 31 are arranged in this order.

[0017] The plane size which contains the height of the case 29, i.e., the liquid crystal projector at the time of receipt, in a case 29 as a configuration which contains the projection lens 27 considered as the dimension below an abbreviation A4 file size. Depth is 307mm and the width of face of the dimension of an example is 230mm.

[0018] In addition, a setup of a dimension is not limited to this example and should just be an abbreviation A4 file size. Although the smallest size was 230mmx307mm of this example as a result of investigating about various A4 file sizes, as larger size a little than it, it was 263mmx318mm as 243mmx307mm and the greatest size. Therefore, in this invention, it decided to set up the three above-mentioned kinds of sizes as an A4 file size.

[0019] According to the liquid crystal projector of the configuration of this example,

the liquid crystal projector of a dimension which can use the receipt shelf which has generally spread widely, and a carrying case can be obtained.

[0020] in addition, although implementation becomes difficult more nearly technically so that this size is small, there is an effect which the receipt shelf and carrying case which have generally spread widely can use of becoming like.

[0021] In order to realize this dimension, in this example, display screen size of a liquid crystal panel is made into 0.9 inches. By using 0.9 inches and a small liquid crystal panel compared with 1.3 inches of the display screen size of the conventional liquid crystal panel, the projection lens 27 and the crossing dichroic prism 25 are made small, and can also make color separation optical system small in connection with this.

[0022] In this example, in order to realize A4 file size, distance from the liquid crystal panel screen to a projection lens tip was set to 135mm. By setting this distance to 135mm or less, smallest A4 file size is realizable. In addition, to larger A4 file size, 146mm or less, then it are [ this distance ] realizable. This is because it is 318mm which has the longitudinal large size of A4 file size, a small thing is 307mm and the difference is 11mm.

[0023] In this example, in order to realize A4 file size, while having the crossing dichroic prism 25 as color composition optical system, the plane size of the crossing dichroic prism 25 was set to 32mmx32mm. With this size, color separation optical system is made more to less than [ 32mmx32mm ], then this small.

[0024] In addition, although this example showed the example of a configuration with the larger depth size of a liquid crystal projector than a width-of-face size, it may not be limited to this and a larger configuration than a depth size is sufficient as a width-of-face size.

[0025] 61 in drawing is a fan for cooling for cooling the above-mentioned liquid crystal panels 14, 18, and 21, and has shown the sirocco fan of a blower mold in drawing. As for the first fan duct and 27, 65 is [ the heat sink for cooling and 70 ] the third fan duct.

[0026] Figs. 4 and 5 are the details perspective diagrams showing the liquid crystal panels 14, 18, and 21 in the above-mentioned example, and said cooling structure of the projector lens 27 perimeter. Fig. 4 shows the perspective diagram from [ said ] an illumination-light study system, and Fig. 5 is a perspective diagram from cooling-fan 61 direction. Moreover, Fig. 6 is the details perspective diagram showing the ventilation structure of said cooling structure. The cooling structure of said liquid crystal panel is explained using Figs. 4, 5, and 6 below.

[0027] The air discharged from the above-mentioned cooling fan 61 is guided under said liquid crystal panels 14, 18, and 21 through said first fan duct 65, as the drawing

Nakaya mark 111 showed. At this time, the first guide plate 123, the second guide plate 124, and the third guide plate 125 are arranged in the first fan duct 65, and the air of said arrow head 111 is a configuration which is divided into the ventilation 112 for liquid crystal panel 14 for B colored light, the ventilation 113 for liquid crystal panel 18 for G colored light, and the ventilation 114 for liquid crystal panel 21 for R colored light, is guided at each liquid crystal panel, and cools each liquid crystal panel. At this time, by arranging each guide plate 123,124,125 appropriately, it arranges so that the maximum blast weight or the maximum wind speed may be led to the ventilation 113 for liquid crystal panel 18 for G colored light with the general highest temperature rise of a panel, and then, it is the configuration that the temperature rise value of each liquid crystal panel can be mostly equated by dividing into the ventilation 112 for liquid crystal panel 14 for B colored light with a high temperature rise, and the ventilation 114 for liquid crystal panel 21 for R colored light which is not so high as for a temperature rise, and ventilating. namely, the wind holes 91, 92, and 93 (not shown) which showed the air for cooling in Fig. 4-- a passage -- the Fig. 6 Nakaya mark 115,116,117 (not shown) -- like -- each -- they are liquid crystal panel 14 and the configuration which cools 18 and 21.

[0028] further -- the above -- cooling -- \*\* -- air -- the -- two -- a fan duct -- 101 -- a passage -- the -- two -- a fan duct -- 101 -- inside and outside -- a wall -- having prepared -- cooling -- \*\* -- a heat sink -- 27 -- radiating heat -- having -- further -- the -- three -- a fan duct -- 70 -- a passage -- the -- four -- a fan duct -- 71 -- a passage -- said -- a cooling fan -- 61 -- returning -- having -- a configuration -- it is . The fan ducts 65, 101, 70, and 71 of this time above-mentioned have structure which sealed liquid crystal panels 14, 18, and 21 and a cooling fan 61. For this reason, penetration of the dust from the outside is prevented, dust adheres on a liquid crystal panel side, and the defect that dust is irradiated on a screen can be prevented. Moreover, the above cooling structure does not need to be sealing structure especially for the formation of a thin form of equipment, and the configuration which stuck dust \*\*\*\* glass separately on the liquid crystal panel side is also possible for the cure of dust.

[0029] Moreover, in the 1st example of the above, although the guide plate 123,124,125 is dividing the ventilation from a cooling fan 61, even if this is structure divided in 3 pipes etc., the same effect is acquired.

[0030] Fig. 7 is the plan of the liquid crystal projector of the 2nd example of this invention.

[0031] Incidence of the illumination light 2 from the discharge lamp 1 which is the light

source is carried out to a dichroic mirror 40 through the polarization sensing element 6, the 1st lens array 7, a mirror 8, and the 2nd lens array 9 through the lamp reflector 3 of a parabolic mirror, a lens 4, and a lens 5.

[0032] The R colored light 41 reflects and G and the B colored light 42 penetrate a dichroic mirror 40. It is reflected by the mirror 13 and incidence of the R colored light 41 is carried out to the liquid crystal panel 14 for R colored light. Incidence is carried out to the dichroic mirror 15 of G colored light reflection and B colored light transparency, the G colored light 16 reflects, and the B colored light 17 penetrates G and the B colored light 42. Incidence of the G colored light 16 is carried out to the liquid crystal panel 18 for G colored light.

[0033] Incidence of the B colored light 17 is carried out to the liquid crystal panel 21 for B colored light through a mirror 19 and a mirror 20.

[0034] Color composition is carried out with the crossing dichroic prism 25, and the R transmitted light 22 from a liquid crystal panel 14, the G transmitted light 23 from a liquid crystal panel 18, and the B transmitted light 24 from a liquid crystal panel 21 project the outgoing radiation light 26 by which color composition was carried out on a screen (not shown) with the projection lens 27.

[0035] In order that the heat generated from the light source which becomes an elevated temperature does not do effect and may carry out it to component parts other than the light source, near a discharge lamp 1 and the lamp reflector 3, the ventilating fan 43 for light source cooling is arranged, and hot blast 45 is exhausted besides the case 44 of a liquid crystal projector.

[0036] Moreover, the lamp power supply 31 is arranged near the discharge lamp 1.

[0037] While equipping the perimeter of the crossing dichroic prism 25 with the 1st dichroic mirror 40, the 2nd dichroic mirror 15, the 1st mirror 13, the 2nd mirror 19, and the 3rd mirror 20 as color separation optical system The use effectiveness of the illumination light from the light source Make it improve and the uniform illumination light The discharge lamp 1 and the lamp reflector 3 which are the light source for obtaining, a lens 4, a lens 5, the polarization sensing element 6, the 1st lens array 7 that is an optical integrator means, a mirror 8, and the illumination-light study system containing the 2nd lens array 9, While having the lamp power supply 31 which is a power supply for the light sources, the list of the projection lens 27, the crossing dichroic prism 25, and color separation optical system, and an illumination-light study system and the lamp power supply 31 are arranged in this order.

[0038] In the example shown in Fig. 7, the above-mentioned cooling fan 61 is arranged to the side of the projection lens 27 as well as said first example, and that of a basic

configuration is the same as that of above-mentioned Fig. 4 and the thing shown in 5 and 6. Although it is necessary to arrange heat insulation plate 60 grade since said cooling fan 61 is arranged near said lamp reflector 3 at this time, and it is easy to be influenced of heat, the effect that a height size can be reduced is the same as here where the whole equipment can be miniaturized.

[0039] The plane size which contains the height of the case 51, i.e., the liquid crystal projector at the time of receipt, in a case 51 as a configuration which contains the projection lens 27 considered as the dimension below an abbreviation A4 file size. Depth is 230mm and the width of face of the dimension of an example is 307mm.

[0040] According to this example, the liquid crystal projector of a dimension which can use the receipt shelf which has generally spread widely, and a carrying case like the 1st example can be obtained.

[0041] In addition, in this example, the projection lens 27 has composition contained by the back to the case 51, and it is effective in the ability to enlarge enough distance from the liquid crystal panel screen to a projection lens tip. Generally, the flexibility of projection lens layout has breadth and the effect that the projection lens of high performance can be obtained more, by enlarging this distance.

[0042] In addition, with a configuration with a larger width-of-face size than a depth size, modification of various layouts is possible.

[0043] Fig. 8 is the plan of the liquid crystal projector of the 3rd example of this invention. The difference from the 2nd example is the point of having devised the layout of the components of ventilating-fan 50 grade, and having considered the projection lens 27 as the configuration which moved to the before side to the case 51. In order that the heat generated from the light source which becomes an elevated temperature does not do effect and may carry out it to component parts other than the light source, near a discharge lamp 1 and the lamp reflector 3, the ventilating fan 50 for light source cooling shifts in a longitudinal direction, is arranged in it, and exhausts hot blast 52 besides the case 51 of a liquid crystal projector.

[0044] In the case of this example, said liquid crystal panels 14, 18, and 21 can be cooled efficiently, without being influenced of the heat from the aforementioned lamp reflector 3 by arranging said cooling fan 61 to the lamp reflector 3 and the opposite side on the side of the projection lens 27. Moreover, at this time, although it is the configuration in which said 1st and 2nd example carried out right-and-left reversal of the cooling structure of said liquid crystal panel, basic structure is the same. Furthermore, as 50in drawing' showed, when the fan of a blower mold is used, an effect is [ said ventilating fan 50 ] said [ the same ] of the end.

[0045] Moreover, according to this example, free space can be made to the backside of a case 51, and the flexibility of layout designs, such as passive circuit elements, can obtain breadth and a more highly efficient and highly efficient circuit.

[0046]

[Effect of the Invention] As explained above, while being able to stop the height size of optical equipments, such as a liquid crystal projector, to the minimum according to this invention, the miniaturization also of a plane outer-diameter size below A4 file size is attained. Especially, a fan can be stationed in space-saving and two or more liquid crystal panels can be cooled to a very efficient almost equal temperature.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Fig. 1] It is the side elevation of the liquid crystal panel circumference of the liquid crystal projector of the 1st example of this invention.

[Fig. 2] It is the side elevation of the liquid crystal panel circumference of the conventional liquid crystal projector.

[Fig. 3] It is the plan of the liquid crystal projector of the 1st example of this invention.

[Fig. 4] It is the perspective diagram of the cooling structure of the liquid crystal projector of the 1st example of this invention.

[Fig. 5] It is the perspective diagram of the cooling structure of the liquid crystal projector of the 1st example of this invention.

[Fig. 6] It is the lower part details perspective diagram of the cooling structure of the liquid crystal projector of the 1st example of this invention.

[Fig. 7] It is the plan of the liquid crystal projector of the 2nd example of this invention.

[Fig. 8] It is the plan of the liquid crystal projector of the 3rd example of this invention.

[Description of Notations]

1 [ — A lens, 5 / — A lens, 6 / — A polarization sensing element, 7 / — The 1st lens array, 8 / — A mirror, 9 / — The 2nd lens array, 10 / — A dichroic mirror, 11 / — R colored light, 12 / — G ] — A discharge lamp, 2 — The illumination light, 3 — A lamp reflector, 4 And B colored light, 13 — A mirror, 14 — A liquid crystal panel, 15 — A dichroic mirror, 16 [ — G colored light, 17 ] [ — B colored light, 18 ] [ — A liquid crystal panel, 19 ] [ — A mirror, 20 ] [ — A mirror, 21 ] [ — A liquid crystal panel, 22 ] [ — R transmitted light, 23 ] [ — G transmitted light, 24 ] [ — B transmitted light, ] 25 [ — A ventilating fan, 29 / — A case, 30 / — Hot blast, 31 / — A lamp power supply,

40 / -- A dichroic mirror, 41 / -- R colored light, 42 / -- G and B colored light, 43 /  
-- A ventilating fan, 44 / -- A case, 45 / -- Hot blast, ] -- A crossing dichroic prism,  
26 -- Outgoing radiation light, 27 -- A projection lens, 28 50 [ -- A cooling fan, 65 /  
-- The first fan duct, 101 / -- The second fan duct, 70 / -- The third fan duct, 71 /  
-- The fourth fan duct, 123 / -- The first guide plate, 124 / -- The second guide plate,  
125 / -- The third guide plate. ] -- A ventilating fan, 51 -- A case, 52 -- Hot blast, 61

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